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Organoleptic Assessment and Proximate Analysis of Stored *Tilapia guineensis*

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ABSTRACT

The organoleptic and proximate analysis of *Tilapia guineensis* were assessed at two stored temperatures, -18ºC and 4ºC for 4 weeks. Graded results revealed a general decline in organoleptic properties such as colour, texture, freshness, and taste of the fishes stored at the two temperatures. Proximate analysis revealed a reduction in crude protein and lipid contents and increases in ash and fibre content of the fish at the two storage temperatures. Moisture content decreased in the samples stored at -18ºC but increased in the 4ºC stored samples. pH of fish was found to increase in the two stored temperatures. It was within the acidic range in the -18ºC stored sample but the alkaline range in the 4ºC stored samples. There were significant differences ''P<0.05'' in the organoleptic and proximate composition of the ice stored *Tilapia guineensis* within the same temperature and between the two temperatures. The quality of the 4°C stored sample deteriorated faster than that of the -18ºC. Thus storage temperature and duration have effects on the nutritional quality of stored fish.

Keywords: Organoleptic assessment; proximate analysis; temperature; Tilapia guineensis.

1. INTRODUCTION

The trend in the world today is towards healthy eating more than ever. People are more conscious of what they eat, associating same with health conditions presently or in later

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years of life Oriakpono et al. (2011). One area where this is observed is in the change from the consumption of red meat due to its high cholesterol content to white meat and fish. Fishes are a major source of high quality protein, and fish occupies an important place in human nutrition (Nargis, 2006). Fish and shell fish contain about 19% protein similar in amino acid composition to that found in muscle meats. The content varies from 1 to 20% depending upon the species and the season of the year. This gives a substantially lower fat content than beef Ndome et al. (2010a). Spoilage of fresh fish can be attributed to series of metabolic processes that cause the fish to be undesirable and unacceptable for human consumption due to changes in sensory and biochemical characteristics Ndome et al. (2010b). The noxious smells from spoilt fish have been suggested to be produced by microbes to repulse large animals, thus reserving the food resource for them while enhancing spoilage and reducing organoleptic properties (Sherrat et al., 2006; Braun and Sutherland, 2005). With the increase in fish consumption, there seem to be a habit of long periods of storage particularly in ice with the thought that the fish remains same and safe for consumption. The emphasis in this study is on the overall nutritional changes in composition of *Tilapia guineensis* stored under two temperature conditions -18ºC and 4ºC.

2. METHODS

2.1 Organoleptic Assessment

The sensory properties of the ice stored *Tilapia guineensis* were evaluated by six trained panel of Judges selected from the unit of Food Microbiology, University of Port Harcourt, Rivers State, Nigeria. Assessment of Colour, texture, freshness and taste were based on both cooked and uncooked fish samples. Questionnaires for the panelists were prepared using the modified 5- point hedonic scale described by Eyo (2001) as follows:

Modified scores	**Remark**
1-1.9	Unacceptable
2-2.9	Fair
3-3.9	Medium
4-4.9	Good
5-6.0	Very good

2.2 Proximate Analysis

The moisture content, ash and crude fibre content, of the samples were assayed as described by the AOAC (2000) while crude lipid extraction was carried out using the AOAC (2000) but with some modifications (Sutharshiny, 2011). Crude protein content was determined using the micro kjeldahl method (Sutharshiny, 2011).

3. RESULTS

3.1 pH

There were significant changes in the pH levels of the fish species with time. The -18ºC sample decreased in pH from 6.81 before cold storage to 6.75 at the expiration of one week, but subsequently increased to 6.85 at the end of four weeks. The 4ºC sample increased in pH from 6.81 before cold storage to 7.20 at the expiration of four weeks. The fish sample was observed to reduce in acidity while tending towards an alkaline state with increase in

storage time. Statistical analysis revealed significant differences ''*P*<0.05'' in pH levels of the fish species stored at the 4ºC temperature and between the two temperatures (Table 1).

Table 1. pH levels of ice stored *Tilapia guineensis*

Storage Time (Weeks)	Storage temperature	
	-18ºC	**4ºC**
0	6.81±0.41^{aA}	6.81±0.14 ^{aA}
1	6.75±0.27^{aA}	6.90±0.12 ^{aA}
2	6.75±0.32^{aA}	7.10±021^{bB}
3	6.80 ±0.16^{aA}	7.15±0.24^{bB}
4	6.85±0.33 ^{aA}	7.20±0.33 ^{bA}

$^{a-b}$ *Different letters in the same column indicate significant difference (P<0.05)*
$^{A-B}$ *Different letters in the same row indicate significant difference (P<0.05)*

3.2 Organoleptic Evaluation

The study revealed a general decline in the physical attributes such as colour, the grade reduced from 4.3 to 3.0 in the -18°C stored sample and from 4.3 to 2.0 in the 4ºC stored sample. The grade for texture of fish varied from 5.5 to 3.0 in the -18ºC stored sample and from 5.5 to 2.2 in the 4ºC stored sample. The grade for freshness dropped significantly from 5.1to 2.5 in the -18ºC stored sample and from 5.1 to 1.6 in the 4ºC stored sample. While the grade for taste of the fish species during ice storage showed a significant decline from 5.3 to 2.4 in the -18ºC stored sample and from 5.3 to 1.5 in the 4ºC stored sample. The decline was higher in the 4ºC stored samples. Statistical analysis of the four parameters assessed for organoleptic characteristics: colour, texture, freshness and taste revealed significant differences ''*P*<0.05'' in the organoleptic characters within the same storage temperatures and between the two temperatures (Table 2).

3.3 Proximate Composition

Proximate analysis of the fish revealed a decrease in the crude protein and lipid content during the study period. Crude protein content of the -18ºC stored sample was found to decrease from 15.13% before cold storage to 11.11% after four weeks, while the 4ºC stored sample decreased from 15.13% to 9.98% after four weeks. Similarly, the lipid content decreased from 14.50% before cold storage to 8.50% after four weeks in the -18ºC stored samples, while for the 4ºC stored samples, lipid content decreased from 14.50% before cold storage to 5.13% after cold storage. Moisture decreased from 55.12% before cold storage to 46.32% after four weeks in the -18ºC stored samples, while the 4ºC stored samples revealed an increase in moisture content from 55.12% before cold storage to 58.10% after four weeks. Ash content of *Tilapia guineensis* stored at -18ºC increased from 16.20% to 27.10% while for the 4ºC stored sample, ash content increased from 16.20% to 24.37% after four weeks. Similarly, crude fiber content showed an increase during the storage period. This increase was from 2.65% before cold storage to 5.43% after cold storage in the -18ºC stored samples and from 2.65% to 4.96% in the 4ºC stored samples. Statistical analysis of the five parameters assessed for proximate composition: crude protein, crude lipid, moisture, ash and fiber revealed significant differences ''*P*<0.05'' in the different compositions within the same storage temperatures and between the two temperatures (Table 3).

Table 2. Organoleptic assessment of ice stored *Tilapia guineensis*

Storage Time (weeks)	Sensory Quality Parameters							
	Colour		Texture		Freshness		Taste	
	-18ºC	4ºC	-18ºC	4ºC	-18ºC	4ºC	-18ºC	4ºC
0	4.3 ± 0.20^{aA}	4.3 ± 0.20^{aA}	5.5 ± 0.30^{aA}	5.5 ± 0.30^{aA}	5.1 ± 0.17^{aA}	5.1 ± 0.17^{aA}	5.3 ± 0.20^{aA}	5.3 ± 0.20^{aA}
1	3.8 ± 0.10^{abB}	3.0 ± 0.20^{bA}	3.9 ± 0.20^{bcB}	3.0 ± 0.20^{bA}	4.0 ± 0.26^{bB}	2.9 ± 0.10^{bA}	4.1 ± 0.20^{bB}	2.9 ± 0.20^{bA}
2	3.5 ± 0.20^{bB}	2.7 ± 0.34^{bcA}	3.5 ± 0.40^{bcB}	2.7 ± 0.17^{bcA}	3.0 ± 0.20^{cB}	2.1 ± 0.20^{bcA}	3.2 ± 0.30^{bcB}	2.3 ± 0.20^{bcA}
3	3.4 ± 0.50^{bB}	2.5 ± 0.36^{cA}	3.3 ± 0.40^{cB}	2.6 ± 0.30^{bcA}	2.9 ± 0.20^{cB}	1.8 ± 0.10^{cA}	2.7 ± 0.26^{cB}	1.9 ± 0.26^{cA}
4	3.0 ± 0.40^{Cb}	2.0 ± 0.10^{cA}	3.0 ± 0.30^{cB}	2.2 ± 0.30^{Ca}	2.5 ± 0.30^{cB}	1.6 ± 0.30^{cA}	2.4 ± 0.20^{cB}	1.5 ± 0.10^{cA}

$^{a-c}$ Different letters in the same column indicate significant difference (P<0.05),
$^{A-B}$ Different letters in the same row indicate significant difference (P<0.05).

Table 3. Proximate Composition of Ice stored *Tilapia guineensis*

Storage time (weeks)	Proximate Composition of Iced stored *Tilapia guineensis*									
	Protein %		Lipid %		Moisture %		Ash %		Fibre %	
	-18ºC	4ºC	-18ºC	4ºC	-18ºC	4ºC	-18ºC	4ºC	-18ºC	4ºC
0	15.13 ±2.23Ca	15.13 ±2.23cA	14.50 ±1.68aA	14.50 ±1.68aA	55.12 ±2.55aA	55.12 ±2.55aA	16.20 ±0.51aA	16.20 ±0.51aA	2.65 ±1.51aA	2.65 ±1.51aA
1	14.20 ±1.07Ba	14.06 ±2.49cA	12.40 ±3.75abB	8.21 ±2.68bA	52.27 ±2.17abA	56.22 ±2.62bB	18.11 ±2.67aB	17.34 ±1.89aAB	2.98 ±0.84aA	3.52 ±1.33bAB
2	13.88 ±1.85bA	12.10 ±2.67bAB	10.92 ±2.25bB	7.34 ±0.43bA	50.09 ±3.62abA	57.17 ±4.22bB	21.34 ±1.97bB	20.17 ±1.60bAB	3.42 ±0.68abA	3.98 ±0.69bA
3	13.24 ±2.37bB	10.33 ±2.05bA	10.07 ±1.34bB	6.10 ±0.35cA	48.11 ±1.85bA	57.75 ±1.46cB	23.40 ±1.68bA	24.22 ±2.48bAB	4.81 ±0.61bA	4.23 ±0.27cA
4	11.11 ±3.78aB	9.98 ±1.80Aa	8.50 ±1.50bB	5.13 ±0.62cA	46.32 ±1.29bA	58.10 ±1.59cB	27.10 ±2.62cB	24.37 ±1.40cA	5.43 ±1.06bB	4.96 ±0.67cAB

a-c Different letters in the same column indicate significant difference ''P<0.05'',
A-B Different letters in the same row indicate significant difference ''P<0.05''

4. DISCUSSION

Organoleptic assessment in this study revealed that the reduction in score of graded parameters such as: color, texture, freshness, and taste varied with storage temperature and time. This reduction can be attributed to the increasing activities of spoilage agents as found in an earlier study (Oriakpono et al., 2011) and biochemical changes occurring therein with increasing time. These changes were observed at the two storage temperatures but occurred more sharply in the 4ºC stored samples. Major changes were observed in freshness and taste which became unacceptable at three weeks storage in the 4ºC stored fish samples. Graded values for colour and texture fell within the range of very good before storage, to the fair range after four weeks. Organoleptic assessment has proven to be an invaluable tool in the evaluation of freshness of fishes. Although a variety of biochemical, physical (Gill, 1992, 1997) and microbiological methods (Gram and Huss, 1996) have been used to assess freshness, the sensory evaluation is still the most satisfactory method to achieve such a goal (Fatma and Ali, 2011).

The pH of fish stored at the -18ºC temperature was observed to initially drop from 6.81 before ice storage to 6.75 after one week storage after which there was a subsequent increase to 6.85 after four weeks. The pH increased with increasing storage time, and showed same pattern at the 4ºC storage. The increase was higher in the 4ºC stored samples than the -18ºC stored sample indicating that biochemical and microbial changes were occurring faster in the flesh of 4ºC stored fish even at these temperatures. The increase observed in pH in this study can also be attributed to the fact that fermentation of carbohydrate to acid was occurring as found within the first week in the -18ºC stored sample. Eyo (2001) showed that pH is an indication of the extent of microbial spoilage in fish. The increase in pH may also indicate the accumulation of alkaline compounds such as ammonia, mainly derived from microbial actions. The increase may also be due to an increase in volatile bases from the decomposition of nitrogenous compounds by endogenous or microbial enzymes (Erkan and Ozden, 2008).

pH as an index is important in determining the quality of fish and it can be used as a guide (Pacheco-Aguilar et al., 2000). The pH of fish flesh and gills has an important influence on its freshness because of its influence on bacterial growth. The lower the pH of fish flesh and gills the slower the bacteria growth and *vice versa* (Okeoyo et al., 2009).

The reduction in crude protein of the fish during ice storage could be attributed to the gradual degradation of the initial crude protein to more volatile products as total volatile bases (TVB), trimethyl amine (TMA) hydrogen sulphide and ammonia (Eyo, 2001) and the changes in protein and lipid content may be associated with the leaching out to ice of some of the lipid fractions (Emokpae, 1979). The reduction in crude protein content of the fish may also have been due to a decrease in salt soluble protein and water soluble protein (Chomnawang et al., 2007) or due to autolytic deterioration associated with the actions of endogenous enzymes and bacteria (Hultman and Rustard, 2004).

The reduction in lipid content may be associated with the oxidation of polyunsaturated fatty acids found in fish tissues to other products as aldehydes, free fatty acids, ketones, and peroxides (Horner 1992). Ash and fibre content decreased during the experimental period. The result of proximate analysis revealed that moisture formed the highest component of the proximate composition of *Tilapia guineensis*. Moisture content was observed to decrease considerably in the -18ºC stored samples but increased slightly in the 4ºC stored samples during the storage period which is due to absorption of moisture from the cool atmosphere.

5. CONCLUSION

This study has revealed that even at these temperatures (-18ºC and 4ºC), as the storage period increases, there are significant changes occurring in the pH and proximate composition of the fish resulting in a decrease in shelf life and market value as graded based on visible organoleptic changes. Cold storage in this study allowed the changes in pH and proximate composition of the fish stored at the two temperatures, though the changes were reduced at the -18ºC temperature. Though deterioration of the fish sample was obvious from the organoleptic and proximate analysis, it was faster in the 4ºC stored samples than the -18ºC stored fish. This study has shown that the shelf life of *T. guineensis* can be remarkably extended if properly stored. Thus it is advisable that fresh fish for consumption stored under freezing conditions of -18ºC should be used within one week of capture to harness the fresh quality state of the fish and avoid changes that may be detrimental to the consumer. This work therefore strongly discourages the practice of prolonged storage of fish and its products in the refrigerator as is a common practice by bachelors and career housewives.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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